

On two rare and poorly known species, *Styłodactylus discissipes* Bate, 1888, and *S. serratus* A. Milne-Edwards, 1881 (Crustacea, Decapoda, Styłodactylidae)

Régis CLEVA

Muséum national d'Histoire naturelle,
Département Milieux et Peuplements aquatiques, USM 0403,
case postale 53, 61 rue Buffon, F-75231 Paris cedex 05 (France)
cleva@mnhn.fr

Alain VAN WORMHOUDT

Muséum national d'Histoire naturelle,
Département Milieux et Peuplements aquatiques,
UMR 5178, Station de Biologie marine,
place de la Croix, BP 225, F-29900 Concarneau (France)
avw@mnhn.fr

Cleva R. & Van Wormhoudt A. 2006. — On two rare and poorly known species, *Styłodactylus discissipes* Bate, 1888, and *S. serratus* A. Milne-Edwards, 1881 (Crustacea, Decapoda, Styłodactylidae). *Zoosystème* 28 (2): 347-358.

ABSTRACT

More than a century after its description from the Kermadec Islands, north of New Zealand, *Styłodactylus discissipes* Bate, 1888 has been rediscovered south of New Caledonia, and in the Austral Islands, French Polynesia. DNA analyses show that specimens from these two widely separated areas clearly belong to the same species, and represent two populations that appear to be in early stages of speciation through isolation. *Styłodactylus discissipes* shares numerous morphological characters with *S. serratus* A. Milne-Edwards, 1881, known from the eastern and western Atlantic, so that the synonymy of the two species could be considered. Molecular data support the small morphological differences observed, giving evidence that these two species are indeed different.

RÉSUMÉ

À propos de deux espèces rares et peu connues, *Styłodactylus discissipes* Bate, 1888, et *S. serratus* A. Milne-Edwards, 1881 (Crustacea, Decapoda, Styłodactylidae). Plus d'un siècle après sa description des îles Kermadec, au nord de la Nouvelle-Zélande, *Styłodactylus discissipes* Bate, 1888 est retrouvé au sud de la Nouvelle-Calédonie et aux îles Australes (Polynésie française). Les analyses moléculaires

KEY WORDS
Crustacea,
Decapoda,
Caridea,
Styłodactylidae,
Styłodactylus,
deep water,
south west Pacific,
Atlantic,
DNA analyses.

MOTS CLÉS
 Crustacea,
 Decapoda,
 Caridea,
 Stylodactylidae,
Styloactylus,
 eau profonde,
 sud-ouest Pacifique,
 Atlantique,
 analyses ADN.

permettent d'établir que les spécimens provenant de ces deux régions éloignées appartiennent bien au même taxon et semblent indiquer par ailleurs qu'il s'agit de deux populations qui commencent à s'isoler. *Styloactylus discissipes* partage de nombreux caractères avec *S. serratus* A. Milne-Edwards, 1881, signalé des deux côtés de l'Atlantique, à tel point que la synonymie de ces deux espèces pouvait être envisagée. Les données moléculaires viennent en appui des petites différences morphologiques observées et confirment que nous nous trouvons bien devant deux espèces distinctes.

INTRODUCTION

Among the Stylodactylidae, very few specimens of *Styloactylus discissipes* Bate, 1888 and *S. serratus* A. Milne-Edwards, 1881 have been collected. The scarcity of specimens has made the evaluation of their morphological differences difficult to appreciate, particularly because many species of the family show a wide range of variations. Until recently, *S. discissipes* was only known from two specimens collected by the *Challenger* from the Kermadec Is., one being the holotype, and another originally used to describe *S. orientalis* Bate, 1888 but subsequently considered a junior synonym of *S. discissipes* (Kemp 1925; Crosnier & Forest 1973). A female specimen reported by Rathbun (1906) as *S. discissipes* from the Hawaiian Is. was considered a different species, and became the holotype of *S. kauaiensis* Figueira, 1971.

During recent French cruises south of New Caledonia (NORFOLK 2, 2003), and French Polynesia (Rapa I., Austral Is., BENTHAUS, 2002) several specimens collected of *Styloactylus* were initially attributed to *S. discissipes*. The taxonomic status of this material was of interest since it came from two widely separated areas, and was morphologically close to *S. serratus*, a species distributed in the eastern and western Atlantic. Specimens of both taxa were used for molecular analysis to compare with morphological studies, although unfortunately tissues from the type material of *S. discissipes*, probably preserved originally in formaline (P. Clark pers. comm.) could not be used. Sequencing of specimens of other species of *Styloactylus* have been done for comparisons, and are also presented herein.

ABBREVIATIONS

CL	carapace length, excluding rostrum, measured from posterior margin of orbit to the posterodorsal border of carapace;
RL	rostral length;
Mxp3	third maxilliped;
P1 to P5	first to fifth pairs of pereiopods;
P/C, P/D	ratio propodus/carpus and propodus/dactylus;
CP	Beam trawl;
DW	Warén dredge;
MNHN	Muséum national d'Histoire naturelle, Paris;
NHM	The Natural History Museum, London;
RMNH	Rijksmuseum van Natuurlijke Historie, Leiden.

DNA ANALYSES

The total DNA was extracted using the CTAB method (Jones 1953) from two pleopods. The specific primers used for the 16S or cytochrome oxidase I PCR were defined from a multiple alignment of some arthropods available in GenBank.

The forward and reverse primers were:

16S crab1 = 5'-AAT TCA ACA TGG AGG TCG CAA-3'
 16S crab2 = 5'-GAA GGT AGC ATA ATC GTT AGT-3'
 COI rev = 5'-TAA GCT TCT GGG TAG TCT GAR TAK CG-3'
 COI fw = 5'-CCA GCT GGA GGA GGA GAY CC-3'

Amplified products yield an approximate 350 and 600 bp for 16S and COI. The PCR conditions were: 40 cycles of 1 mn at 94°C, 1 mn at 52°C (56°C for COI) and 1 mn at 72°C. The PCR products were

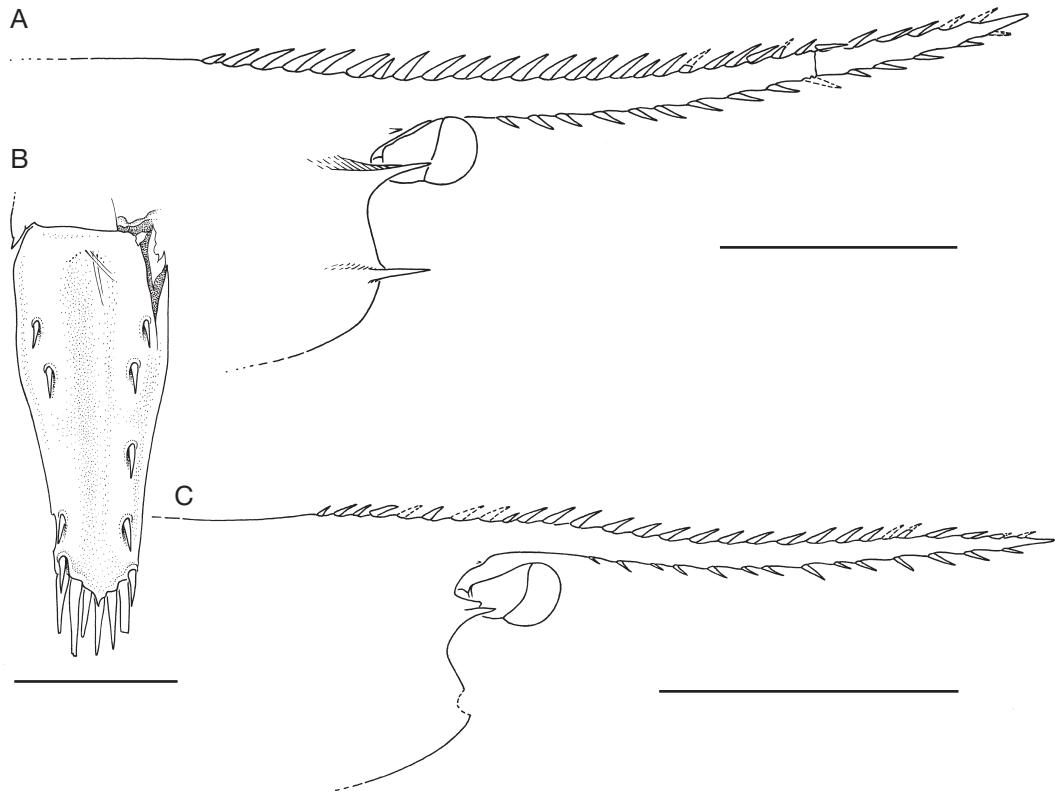


FIG. 1. — *Stylocryptulus discissipes* Bate, 1888, anterior part of body and eye, lateral (A, C) and telson, dorsal (B); A, B, ♀ 11 mm, Kermadec Is., Challenger, stn 171, holotype of *S. orientalis* (NHM 88-22); C, ♀ 8 mm, holotype, same origin, same registration number. Scale bars: A, C, 5 mm; B, 3 mm.

sequenced directly on a ABI Prism 310 Applied automated Biosystem. The sequences of these products without the 5' and 3' end primers were aligned using the CLUSTAL W (Thompson *et al.* 1994) program giving directly the percentage of divergence (uncorrected percentage of substitutions).

SYSTEMATICS

Family STYLODACTYLIDAE Bate, 1888
Genus *Stylocryptulus* A. Milne-Edwards, 1881

***Stylocryptulus discissipes* Bate, 1888**
(Figs 1; 2; 4A; Table 1)

Stylocryptulus discissipes Bate, 1888: 851, pl. 138, fig. 1.

Stylocryptulus orientalis Bate, 1888: 854, pl. 138, fig. 2.

Non *Stylocryptulus discissipes* — Rathbun 1906: 927, fig. 75, pl. 23, fig. 1 (= *Stylocryptulus kauaiensis* Figueira, 1971).

MATERIAL EXAMINED. — Kermadec Islands (North of New Zealand). Challenger, stn 171, 28°33'S, 177°50'W, trawl, 1097 m, 15.VII.1874, 1 ♀ c. 8 mm (holotype), 1 ♀ 11 mm (holotype of *S. orientalis*) (NHM 88-22).

New Caledonia, Norfolk Ridge. NORFOLK 2, stn DW 2054, 23°40'S, 168°15'E, 736-800 m, 24.X.2003, 1 ♀ 6 mm (MNHN-Na 15728). — Stn DW 2065, 25°16'S, 168°56'E, 750-800 m, 26.X.2003, 1 ♀ 13.5 mm (MNHN-Na 15729). — Stn DW 2072, 25°21'S, 168°57'E, 1000-1005 m, 26.X.2003, 2 ovig. ♀♀ 13 and 14 mm (MNHN-Na 15730). — Stn DW 2080, 25°20'S, 168°19'E, 764-816 m, 27.X.2003, 1 ♀ c. 12 mm (carapace damaged) (MNHN-Na 15731).

French Polynesia, Austral Archipelago, E of Rapa.

TABLE 1. — Data concerning *Styloceratus discissipes* Bate, 1888. Abbreviations: **CL**, carapace length (in mm); **RL**, rostrum length; **P3, P4, P5**, last three pairs of pereiopods; **P/C, P/D**, ratio propodus/carpus and propodus/dactylus; **abd. 6**, sixth abdominal somite; **scapho**, scaphocerite; **Telson L/w**, ratio length/width of telson.

Specimen, sex, coll. no.	Locality depth (m)	CL	RL/CL	Rostral formula	Scapho/ CL	Telson/ CL	Telson/ abd. 6	Telson L/w	P3: Merus spines	P3: P/C P/D	P4: Merus spines	P4: P/C P/D	P5: Merus spines	P5: P/C P/D
♀, NHM 88-22, holotype	Kermadec Is. 1097	11	1.3	30(6)/15	0.46	0.62	—	2.5	11-11	2.1 4.8	13-	1.9 5.1	—	—
♀, NHM 88-22, holotype	Kermadec Is. 1097	8	1.4	28(6)/14	—	—	—	—	10-	—	11-	—	11-	—
<i>of S. orientalis</i>														
♀ ov., MNHN-Na 15730	N. Caledonia 1000-1005	14	1.35	28 + (6)/16 tip missing	0.45	0.70	1.6	2.6	8-	2.0 6.0	12-	—	10-11 9.0	2.1
♀ ov., MNHN-Na 15730	N. Caledonia 1000-1005	13	—	— (6) —	—	0.68	1.7	2.7	—	—	—	—	—	—
♀, MNHN-Na 15731	N. Caledonia c. 12 764-816	—	—	— (6) —	—	—	1.8	2.7	10-10	2.2 5.5	12-	2.2 6.7	10-12 7.5	2.2
♀, MNHN-Na 15729	N. Caledonia 750-800	13.5	—	— (6) —	0.46	0.68	1.8	2.6	—	—	—	—	—	—
♀, MNHN-Na 15728	N. Caledonia 736-800	c. 6	—	— (4) —	0.48	—	—	—	4-	1.8 4.8	12-	—	11-	—
♀, MNHN-Na 15725	Austral Is. 840-1200	c. 13.5	1.2	27(5)/20	0.45	0.67	1.8	2.6	12-12	2.2 4.7	12-13 4.9	1.9 6.3	12-12 5.5	1.8
♀, MNHN-Na 15726	Austral Is. 840-1200	10	1.6	33(5)/19	0.52	0.68	1.6	2.7	12-13	2.1 4.8	14-14 5.5	2.0	—	—
♀ MNHN-Na 15726	Austral Is. 840-1200	15	—	— (5) —	—	0.70	1.6	2.5	—	—	—	—	—	—
♀ ov., MNHN-Na 15726	Austral Is. 840-1200	16	1.2	30(7)/17 tip missing	0.46	0.68	1.7	2.6	9-	2.1 5.2	—	—	—	—
♂, MNHN-Na 15726	Austral Is. 840-1200	15	—	— (6) —	0.45	0.64	1.6	2.7	—	—	—	—	—	—
♀ ov., MNHN-Na 15727	Austral Is. 900-1300	16.5	c. 1.25	26 + (5)/17 + tip missing	0.44	0.72	1.7	2.8	10-11	2.1 5.9	12-	2.1 6.9	11- 8.3	2.0
♂, MNHN-Na 15727	Austral Is. 900-1300	12-13	—	— (5) —	—	—	—	2.8	—	—	13-	—	—	—
	Na 15727	900-1300	damaged											

BENTHAUS, stn CP 1910, 27°38.2'S, 144°15.4'W, 840-1200 m, 10.XI.2002, 1 ♀ 13.5 mm, photographed (MNHN-Na 15725); 1 ♂ 15 mm, 3 ♀♀ (1 ovig.) 10-16 mm (MNHN-Na 15726). — Stn CP 1911, 27°37.9'S, 144°15.2'W, 900-1300 m, 10.XI.2002, 1 ♂ c. 12 or 13 mm (carapace damaged), 1 ovig. ♀ 16.5 mm (MNHN-Na 15727).

DISTRIBUTION. — Kermadec Is., 1097 m; New Caledonia, 736-1005 m; French Polynesia, Austral Is. (Rapa Is.), 840-1300 m.

DIAGNOSIS. — Carapace with small supra-orbital spine. Antennal and branchiostegal spines well developed. Rostrum 1.2 to 1.6 times longer than carapace, bearing from 27 to 33 dorsal spines (four to seven on carapace proper, usually five or six), and from 14 to 20 ventral spines. Telson 0.62 to 0.72 carapace length and 1.6 to 1.8 longer than sixth abdominal somite. All abdominal pleura rounded. Antennal scale with outer edge entire except for terminal spine, about half length of carapace. Merus of last three pairs of pereiopods bearing series of strong external spines as follows: P3: eight to 13 (four

for smallest specimen MNHN-Na 15728); P4: 12 to 14; P5: 10 to 12. Ratios P/C and P/D of last three pereiopods ranging as follows: P3: 1.8 to 2.2 and 4.7 to 6.0; P4: 1.9 to 2.2 and 4.9 to 6.9; P5: 1.8 to 2.2 and 6.3 to 9.0.

COLORATION (FIG. 4A)

The colour photograph of a specimen collected from Rapa during BENTHAUS cruise (female 13.5 mm, MNHN-Na 15725) reveals no special pattern: general colour of body yellowish with anterior part of cephalothorax reddish; rostrum translucent; Mxp3, P1, P2 pinkish, other pereiopods pale yellowish; parts of telson and pleopods pale pinkish.

REMARKS

A summary of morphological data for the specimens studied is provided in Table 1.

As previously mentioned, only two specimens of *Styloceratus discissipes* were known, both from

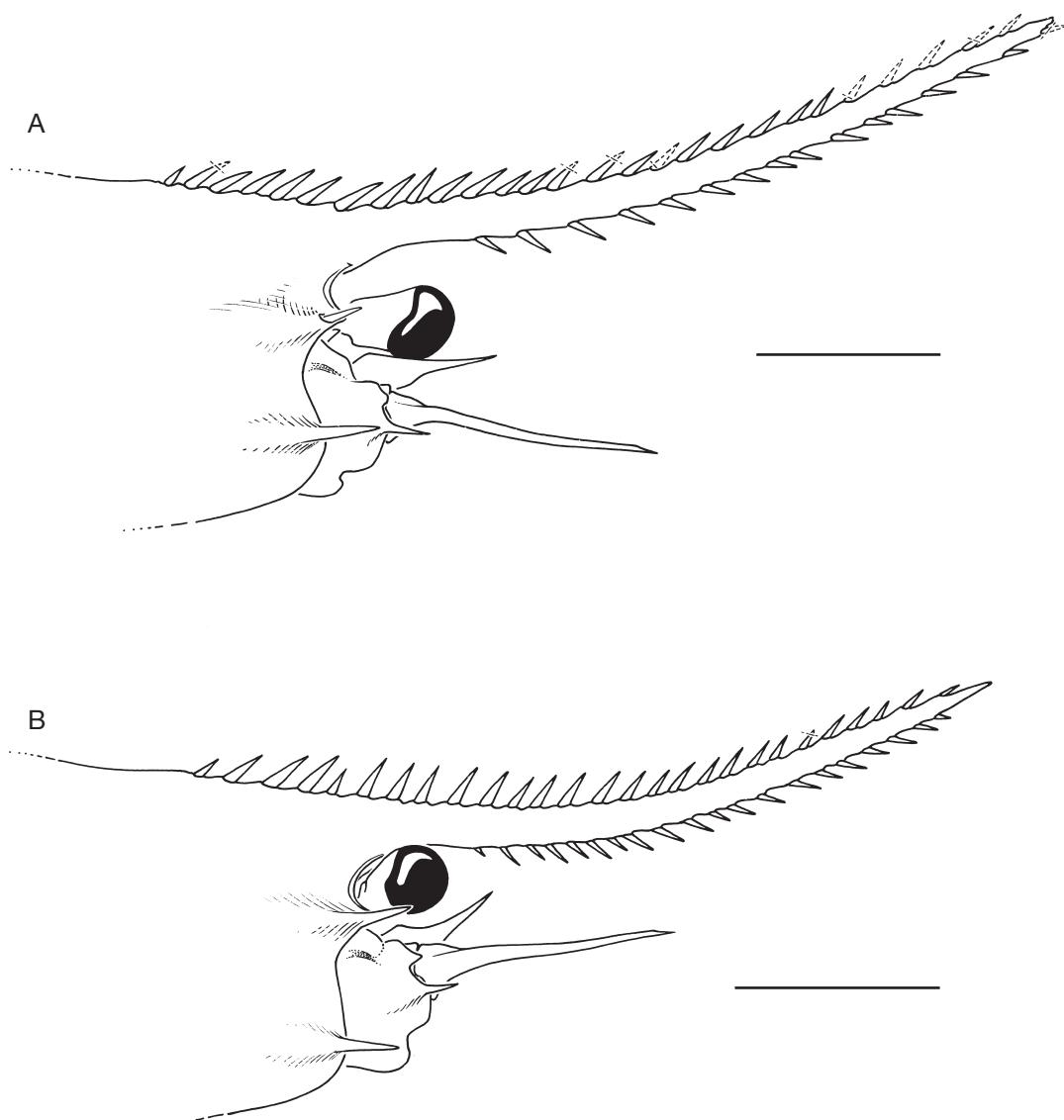


FIG. 2. — *Styloceratus discissipes* Bate, 1888, anterior part of body with eye, stylocerite and antennal scale: **A**, ovigerous ♀ 14 mm, New Caledonia, Norfolk Ridge, NORFOLK 2, Alis, stn DW 2072 (MNHN-Na 15730); **B**, ♀ 13.5 mm, French Polynesia, Austral Is., east of Rapa I., BENTHAUS, Alis, stn CP 1910 (MNHN-Na 15725). Scale bars: 5 mm.

Challenger station 171. The synonymy of *S. orientalis* with *S. discissipes* was evident to Kemp (1925: 258) and Crosnier & Forest (1973: 131). We have reexamined Bate's two females (8 and 11 mm CL), both in poor condition, and have illustrated them (Fig. 1). The telson of the small-

est female is incomplete. The telson of the largest female is abnormal, having four dorsal spines on one side and three on the other; there are four pairs of spines at its extremity, which appears enlarged, whereas three pairs are usually present in all species of the genus.

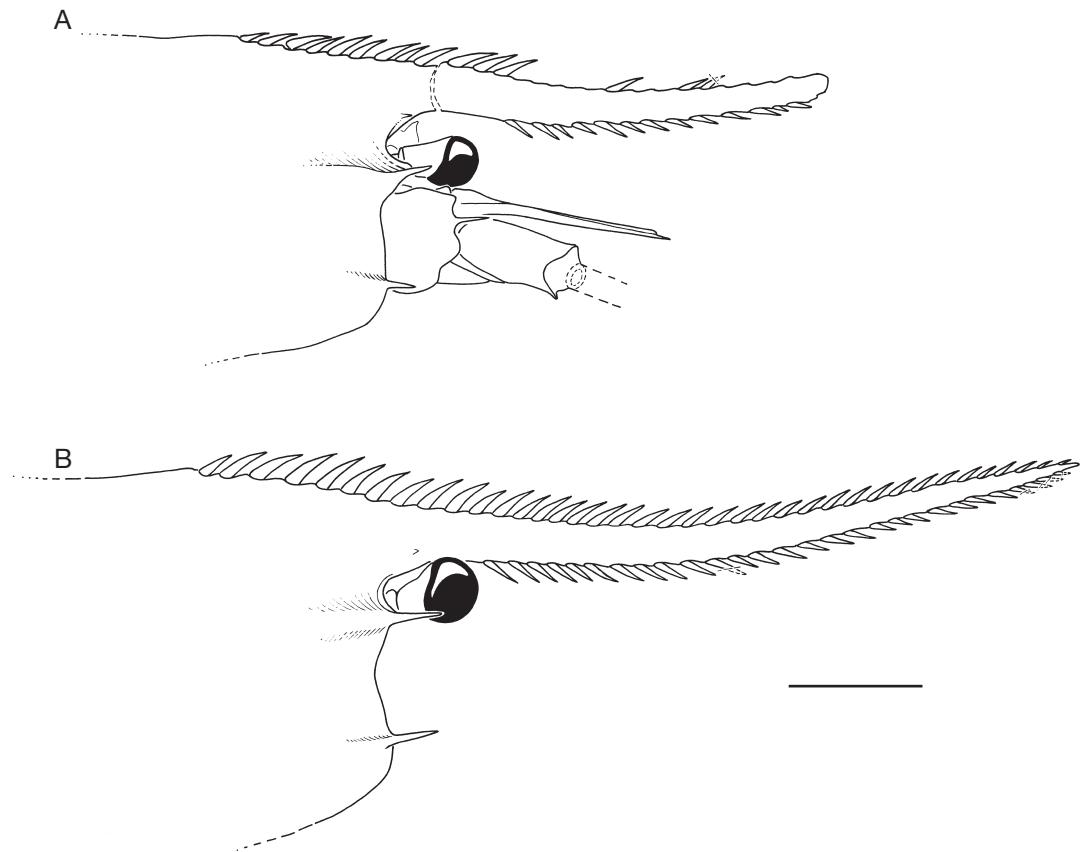


FIG. 3. — *Stylocryptus serratus* A. Milne-Edwards, 1881, anterior part of body with eye (B), antennal scale (A): A, ovigerous ♀ 17.5 mm, holotype, West Indies, off Dominique I., Blake, stn 190 (MNHN-Na 7992); B, ovigerous ♀ 21 mm, off Gibraltar Strait, SEAMOUNT 1 ATLANTIQUE, stn CP 50 (MNHN-Na 15732). Scale bar: 5 mm.

Stylocryptus serratus A. Milne-Edwards, 1881
(Figs 3; 4B; Table 2)

Stylocryptus serratus A. Milne-Edwards, 1881: 11; 1883: pl. 36. — Faxon 1896: 160. — Figueira 1971: 2, fig. 1. — Crosnier & Forest 1973: 129, fig. 36a-f. — Cleva 1990: 166. — Fransen 1991: 191. — Forest & Holthuis 1997: 102 (pl. 36): 113, 116 (pl. A, appendix 1). — d'Udekem d'Acoz 1999: 92.

Non *Stylocryptus serratus* — Stebbing 1914: 51, pl. 12 (= *Stylocryptus stebbingi* Hayashi & Miyake, 1968).

MATERIAL EXAMINED. — **Western Atlantic, West Indies.** U.S. Coast Survey, Caribbean Islands Exploration, Blake, stn 190, off Dominique Island, 958 m, 1878-1879, A. Agassiz coll., 1 ovig. ♀ 17.5 mm, holotype (MNHN-Na 7992). — U.S. Coast Survey, Caribbean

Islands Exploration, off Martinique Island, Blake, stn 205, 14°25.15'N, 60°56.35'W, 611 m, 10.II.1879, A. Agassiz coll., 1 ♂ 13 mm (MNHN-Na 1850); 1 ♂ 17 mm (MNHN-Na 11276). — SE of St. Vincent, Pillsbury, stn P-881, 13°20.8'N, 61°02.5'W, 576-842 m, Blake trawl, 6.VII.1969, 1 ♂ 17.5 mm; 1 ♀ 20.5 mm (RMNH D 38033). — N of Monserrat, Pillsbury, stn P-954, 16°55.0'N, 62°43.0'W, 686-1043 m, Blake trawl, 18.VII.1969, 1 ♂ 12.5 mm; 1 ovig. ♀ 18 mm (RMNH D 38034).

Eastern Atlantic, off south Portugal (Banc Joséphine). SEAMOUNT I ATLANTIQUE, stn CP 50, 36°47.4'N, 14°31.7'W, 1360-1380 m, 6.X.1988, 1 ovig. ♀ 21 mm (MNHN-Na 15732).

Canary Islands. CANCAP 2, stn 131, SW of Hierro, off Punta de Orchilla, 27°40'N, 18°10'W, 1200-1800 m, Agassiz trawl, 8.IX.1977, 2 ♀♀ 18 and 19.5 mm (ovig.) (RMNH D 38035).

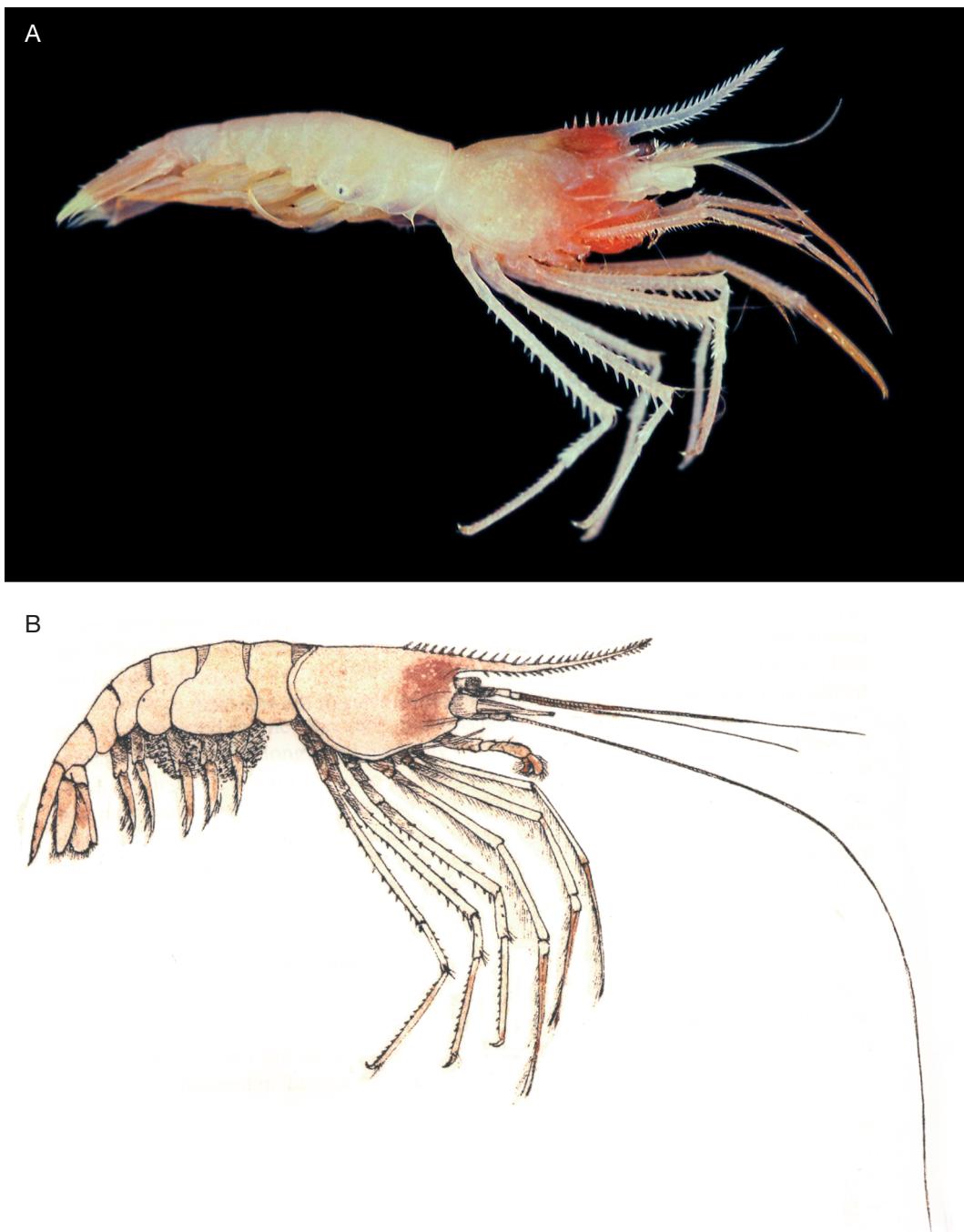


FIG. 4. — Colour pattern: **A**, *Stylocryptulus discissipes* Bate, 1888, ♀ 13.5 mm, French Polynesia, Austral Is., east of Rapa I., BENTHAUS, Alis, stn CP 1910 (MNHN-Na 15725); **B**, *Stylocryptulus serratus* A. Milne-Edwards, 1881 (from Forest & Holthuis 1997).

TABLE 2. — Data concerning *Styloactylus serratus* A. Milne-Edwards, 1881. Notes: 1, according to plate 36 of A. Milne-Edwards (1883); 2, according to the reconstitution done from the type figure by Crosnier & Forest (1973: 129); 3, propodus + dactylus detached, probably belonging to P3; 4, appendages detached, may belong to P4 or P5. Abbreviations: see Table 1.

Specimen sex, coll. no.	Locality depth (m)	CL	RL/CL	Rostral formula	Scapho/CL	Telson/CL	Telson/abd. 6	Telson L/w	P3: Merus spines	P3: P/C P/D	P4: Merus spines	P4: P/C P/D	P5: Merus spines	P5: P/C P/D
♀ ov., MNHN-Na 7992, holotype	West Indies Dominique 991	17.5	c. 1.3(1)	27+(7)/14+36(7)/27(1)	0.48	0.69	1.7	2.9	13-13	—	15	—	—	—
♂, MNHN-Na 1850	West Indies Martinique 611	13	—	— (7) —	—	—	—	—	14-15	—	—	—	—	—
♂, MNHN-Na 11276	West Indies Martinique 611	17	c. 1.3	37+(8)/20+	0.49	0.68	1.7	2.7	14-13	2.1 5.5	15-15	2.2 6.8	13-12	2.0 7.6
♀, RMNH D 38033	West Indies St. Vincent 576-842	20.5	—	— (7) —	0.47	0.71	1.7	2.7	14-	—	—	—	—	—
♂, RMNH D 38033	West Indies St. Vincent 576-842	17.5	c. 1.5 tip missing	28+(7)/16+	0.49	0.66	1.8	3? (deformed)	—	—	—	—	—	—
♀ ov., RMNH D 38034	West Indies Montserrat 686-1043	18	—	— (7) —	—	0.72	1.7	2.8	15-	—	17-17	2.1 8.2	15-	2.0 10.5
♂, RMNH D 38034	West Indies Montserrat 686-1043	12.5	c. 1.7 tip missing	35+(7)/23+	0.50	0.67	1.6	2.7	15-	2.2 5.6	15-15	2.2 —	13	2.2 —
♂, MNHN-Na 1851	Spanish Sahara 1435	12.5	— 1.3(2)	27+(8)/10+ 43(8)/25(2)	0.52	0.68	1.7	2.7	13-	2.1 4.5	13	—	12	—
♀ ov., MNHN-Na 15732	off Gibraltar 1360-1380	21	1.25	38(7)/28	0.46	0.71	1.8	2.6	13-13	2.1 5.0	15-14	2.0 7.1	13-14	1.9 8.5
♀ ov., RMNH D 38035	Canary Is. 1200-1800	19.5	—	— (8) —	0.50	0.75	1.7	2.7	13-13	—	16-	—	—	—
♀, RMNH D 38035	Canary Is. 1200-1800	18	—	32+(7)/17+	0.50	0.69	1.7	2.7	13-13	2.2 6.4?(3)	16-16	— 8.0?(4)	13	— 8.0?(4)

Rio de Oro, Spanish Sahara (currently Morocco). *Talismann*, stn 73, 25°39'N, 16°06'W, 1435 m, 9.VII.1883, 1 ♂ 12.5 mm (MNHN-Na 1851).

DISTRIBUTION. — Western Atlantic: West Indies, 576-1043 m. Eastern Atlantic: off south Portugal (Banc Joséphine), 1360-1380 m; Canary Is., 1200-1800 m; Rio de Oro (Spanish Sahara), 1435 m.

DIAGNOSIS. — Carapace with very small supra-orbital spine, antennal and branchiostegal spines well developed. Rostrum 1.25 to 1.7 times longer than carapace, with 38 dorsal and 28 ventral spines on the unique specimen with intact rostrum; seven or eight spines on carapace proper, behind orbit. Telson 0.66 to 0.75 carapace length, and 1.6 to 1.8 longer than sixth abdominal somite. Abdominal pleurae rounded. Antennal scale with outer edge entire except for terminal spine, about half length of carapace. Merus of last three pairs of pereiopods bearing series of strong external spines: P3: 13 to 15; P4: 13 to 17; P5: 12 to 15. Ratios P/C and P/D of last three pereiopods ranging as follows: P3: 2.1 to 2.2 and 4.5 to 5.5 (6.4?); P4: 2.0 to 2.2 and 6.8 to 8.2; P5: 1.9 to 2.2 and 7.6 to 10.5.

COLORATION (FIG. 4B)

A. Milne-Edwards's illustration published by Forest & Holthuis (1997: 116), reproduced herein (Fig. 4B), indicates that coloration of this species is very similar to that of *S. discissipes*.

REMARK

A summary of morphological data for the specimens studied is provided in Table 2.

MOLECULAR ANALYSIS

The mtDNA sequences of 16S ribosomal RNAs of *Styloactylus discissipes* (AM076941); *S. libratus* (AM076942); *S. multidentatus* (AM076943); *S. serratus* (AM076944) and *S. pubescens* (AM076945) were deposited on Genbank and haplotypes from different localities are given in Appendix 1.

The mtDNA coding for the cytochrome oxidase subunit I (COI) of *S. pubescens* (AM076946); *S. multidentatus* (AM076947); *S. libratus* (AM076948); *S. serratus* (AM076949) and *S. dississippiensis* (AM076950) were deposited on Genbank and haplotypes from different localities are given in Appendix 2.

The amplified products without the primers of mtDNA sequences of *Stylocryptulus serratus* and *S. dississippiensis* were aligned and compared with those of *S. multidentatus* Kubo, 1942, *S. pubescens* Burukovsky, 1990 and *S. libratus* Chace, 1983.

Inside the 16S sequences 1.7-2.3% divergence was observed between *Stylocryptulus serratus* and *S. dississippiensis* corresponding to five to seven base changes among 300 bp. This difference is smaller than with other species of the same group (6 to 8.7%). Between two different individuals from two different locations of *S. serratus* and *S. dississippiensis*, only one base change was observed (Appendix 1; Table 3).

Inside the COI sequences, 6.7 to 7.1% divergence was observed between *S. serratus* and *S. dississippiensis* corresponding to 34-38 base changes among 563 bp. The difference is smaller than with other species (14.8 to 15.8%). Between the different locations four base changes were observed for *S. dississippiensis* and two for *S. serratus* (Appendix 2; Table 4).

DISCUSSION

Specimens of *Stylocryptulus dississippiensis* from New Caledonia (NORFOLK 2), and French Polynesia (BENTHAUS) are considered to represent the same species, although it is possible that populations from these two widely separate regions may be in early stages of speciation. Additional specimens will need to be studied to evaluate this possibility.

Stylocryptulus dississippiensis is very close to *S. serratus*. The two species are similar in coloration; however, morphologically they differ as follows:

- Rostrum armature: the number and arrangement of rostral spines is from 27 to 33 dorsally, and 14 to 20 ventrally in *S. dississippiensis*, whereas it is

TABLE 3.— Divergence and similarity between 16S nucleotide sequences of specimens of five different *Stylocryptulus* species from various localities. 1, *S. multidentatus*, Fiji Is. (MNHN-Na 14981); 2, *S. dississippiensis*, Austral Is. (MNHN-Na 15726); 3, *S. dississippiensis*, New Caledonia (MNHN-Na 15731); 4, *S. libratus*, Marquesas Is. (MNHN-Na 13457); 5, *S. pubescens*, Sala y Gomez Ridge, paratype (no. 3/81729); 6, *S. serratus*, Canary Is. (RMNH D 38035); 7, *S. serratus*, Gibraltar (MNHN-Na 15732); 8, *S. serratus*, West Indies, St. Vincent (RMNH D 38033).

Percent divergence	Percent similarity							
	1	2	3	4	5	6	7	8
1	90.3	90.6	94.0	97.3	91.0	90.6	91.0	
2	7.7	99.7	88.3	92.3	98.0	97.3	98.0	
3	7.4	0.3		88.6	92.6	98.3	97.7	98.3
4	5.0	8.7	8.4		96.0	87.3	87.3	87.3
5	2.3	6.0	5.7	3.4		91.3	91.3	91.3
6	7.0	2.0	1.7	8.7	6.0		99.7	100.0
7	7.4	2.3	2.0	8.7	6.0	0.3		99.7
8	7.0	2.0	1.7	8.7	6.0	0.0	0.3	

TABLE 4.— Divergence and similarity between COI nucleotide sequences of specimens of five different *Stylocryptulus* species from various localities. 1, *S. multidentatus*, Fiji Is. (MNHN-Na 14981); 2, *S. dississippiensis*, Austral Is. (MNHN-Na 15726); 3, *S. dississippiensis*, New Caledonia (MNHN-Na 15731); 4, *S. libratus*, Marquesas Is. (MNHN-Na 13457); 5, *S. aff. pubescens*, Tonga Is. (MNHN-Na 15030); 6, *S. serratus*, Canary Is. (RMNH D 38035); 7, *S. serratus*, Gibraltar (MNHN-Na 15732); 8, *S. serratus*, West Indies, St. Vincent (RMNH D 38033).

Percent divergence	Percent similarity							
	1	2	3	4	5	6	7	8
1		84.5	84.5	90.4	89.9	84.0	83.8	84.0
2	14.9		99.3	85.3	84.9	93.1	93.3	92.9
3	14.9	0.7		85.3	84.5	93.4	93.3	93.3
4	9.4	14.4	14.4		93.3	84.7	84.9	84.7
5	9.8	14.9	15.3	6.6		85.4	85.6	85.4
6	15.6	6.9	6.6	15.1	14.6		99.8	99.8
7	15.8	6.7	6.7	14.9	14.4	0.2		99.6
8	15.6	7.1	6.7	15.1	14.6	0.2	0.4	

38 dorsally and 28 ventrally on the unique specimen with intact rostrum in *S. serratus*; the rostral spines are more closely arranged in *S. serratus* (see Figs 1-3) than in *S. dississippiensis*; seven or eight dorsal spines are situated on the carapace posterior to the orbit in *S. serratus*, whereas there are five or six in *S. dississippiensis*.

- The number of external spines on each merus of the last three pairs of pereiopods are, respectively: P3: 8 to 13; P4: 12 to 14; P5: 10 to 12 in

S. discissipes, and: 13 to 15; 13 to 17; 12 to 15 in *S. serratus*.

— Ratio P/D of each of the last three pairs of pereiopods is, respectively: P3: 4.7-6.0; P4: 4.9-6.9; P5: 6.3-9.0 in *S. discissipes*, and 4.5-5.5; 6.8-8.2; 7.6-10.5 in *S. serratus*.

These differences are subtle, considering the sometimes large variation observed for some species of the family, when large series of specimens are available.

So much so that we were faced by the question of the synonymy of the two taxa, about which a molecular approach was hoped to bring the solution.

Results of DNA analyses provide evidence that *S. serratus* and *S. discissipes* indeed are genetically different species, although the low level of genetic difference suggests early stages of divergence. By using the COI clock established with crustaceans across the Isthmus of Panama (Knowlton *et al.* 1993) this would suggest a separation in the order of 3.5 to 3.9 million years. Different population of the same species may exist also but more studies are necessary to confirm this hypothesis.

Dedication

This paper is dedicated to Patsy A. McLaughlin for her large and fundamental contributions to the knowledge of Crustacea, particularly the Paguroidea.

Acknowledgements

Thanks are extended to C. H. J. M. Fransen (Nationale Natuurhistorisch Museum, Leiden), P. Clark (The Natural History Museum, London), R. Lemaitre (National Museum of Natural History, Smithsonian Institution, Washington, D.C.), for replied to our request and arranging loans. J.-F. Dejouannet (Institut de Recherche pour le Développement) inked the figures and organised the plates. K.-I. Hayashi (National Fisheries University, Shimoseki), S. Samadi (Institut de Recherche pour le Développement) and A. Machordom (Museo Nacional de Ciencias Naturales, Madrid) reviewed the manuscript, and we wish to express to them our sincere gratitude.

REFERENCES

- BATE C. S. 1888. — Report on the Crustacea Macrura collected by H.M.S. *Challenger* during the years 1873-76. *Challenger Reports, Zoology* 24: i-xc, 1-942, figs 1-76, pls 1-150.
- CLEVA R. 1990. — Sur les Stylodactylidae (Crustacea, Decapoda, Caridea) de l'Atlantique. *Bulletin du Muséum national d'Histoire naturelle* 4^e sér., sect. A, 12 (1): 165-176.
- CROSNIER A. & FOREST J. 1973. — Les crevettes profondes de l'Atlantique oriental tropical. Éditions de l'ORSTOM, *Faune tropicale* 19: 1-409, figs 1-121.
- FAXON W. 1896. — Supplementary notes on the Crustacea. Reports on the results of dredgings, under the supervision of Alexander Agassiz, in the Gulf of Mexico and the Caribbean Sea, and on the east Coast of the United States, 1877 to 1880, by the U.S. Coast Survey steamer *Blake*. *Bulletin of the Museum of Comparative Zoology*, Harvard 30: 151-166, pls 1, 2.
- FIGUEIRA A. J. G. 1971. — Materials for a revision of the family Stylodactylidae (Crustacea Decapoda: Caridea). I. Description of a new genus and of a new species. *Archivos do Museu Bocage* (2) 3 (1): 1-8, fig. 1.
- FOREST J. & HOLTHUIS L. B. (eds) 1997. — *A. Milne-Edwards: Recueil de figures de Crustacés nouveaux ou peu connus, 1883. Nouvelle édition en fac-similé avec des commentaires et annotations*. Backhuys Publishers, Leiden, 128 p.
- FRANSEN C. H. J. M. 1991. — *Crustacea of the CAN-CAP and MAURITANIA Expeditions. Preliminary Report*. Nationaal Natuurhistorisch Museum, Leiden, 200 p.
- JONES A. 1953. — The isolation of bacterial nucleic acids using cetyltrimethylammonium bromide (cetavlon) CTAB. *Biochimica Biophysica Acta* 10: 607-612.
- KEMP S. 1925. — Notes on Crustacea Decapoda in the Indian Museum. XVII. On various Caridea. *Records of the Indian Museum* 27: 249-343, figs 1-24.
- KNOWLTON N., WEIGT L. A., SOLORANZO L. A., MILLS D. K. & BERMINGHAM E. 1993. — Divergence in proteins, mitochondrial DNA, and the reproductive compatibility across the Isthmus of Panama. *Science* 260: 1629-1632.
- MILNE-EDWARDS A. 1881. — Description de quelques Crustacés Macroures provenant des grandes profondeurs de la mer des Antilles. *Annales de Sciences naturelles (Zoologie)* (6) 11 (4): 1-16.
- MILNE-EDWARDS A. 1883. — *Recueil de figures de Crustacés nouveaux ou peu connus*. 1^{ère} livraison: 1-3, pls 1-44.
- RATHBUN M. J. 1906. — The Brachyura and Macrura of the Hawaiian Islands. *Bulletin of the United States Fish Commission* 23 (3): 827-930.
- STEBBING T. R. R. 1914. — South African Crustacea (Part VII of S. A. Crustacea, for the Marine Investi-

gations in South Africa). *Annals of the South African Museum* 15: 1-55, 7 figs, pls 1-12.

THOMPSON J. D., HIGGINS D. G. & GIBSON T. J. 1994. — CLUSTAL W: improving the sensitivity of progressive multiple sequence alignment through sequence weighting, positions-specific gap penalties

and weight matrix choice. *Nucleic Acids Research* 22: 4673-4680.

UDEKEM D'ACOZ C. d' 1999. — Inventaire et distribution des crustacés décapodes de l'Atlantique nord-oridental, de la Méditerranée et des eaux continentales adjacentes au nord de 25°N. *Patrimoines naturels* 40: 1-383.

*Submitted on 20 June 2005;
accepted on 30 November 2005.*

APPENDIX 1

Haplotypes of 16S genes for specimens of five different species of *Stylocryptulus* from various localities. **1**, *S. discissipes*, Austral Is. (MNHN-Na 15726); **2**, *S. discissipes*, New Caledonia (MNHN-Na 15731); **3**, *S. serratus*, Canary Is. (RMNH D 38035); **4**, *S. serratus*, West Indies, St. Vincent (RMNH D 38033); **5**, *S. serratus*, Gibraltar (MNHN-Na 15732); **6**, *S. libratus*, Marquesas Is. (MNHN-Na 13457); **7**, *S. pubescens*, Sala y Gomez Ridge, paratype (no. 3/81729); **8**, *S. multidentatus*, Fiji Is. (MNHN-Na 14981).

	10	20	30	40	50	60	70	80	90	100	110	120
1	TACGCTGTATCCCTAAAGTAACCTTACCTTTAACCTTAAAAAGGGCAATAATCTATTATAAATATTAAATTATCAAACAGTTAAAATTAT											
2												
3												
4												
5												
6	C.....											
7	C.....											
8	C.....											
	130	140	150	160	170	180	190	200	210	220	230	240
1	AACTTATTTAATTCAITTAATATAAATTAAACTAAAGTTCACITGTAAAGTTATAGGGCTTATCGTCCCTTCAGTTATTTAACGCTTTCACTAAAAGTAAAGTTAAA											
2												
3												
4												
5												
6	.C...CC.....	T.....										
7	.C...C.....	T.....										
8	GC.G.....	C..T.....										
	250	260	270	280	290	300						
1	TTACACCAGTAAGACAGCTGCCCTTTGTCACCATTCATTCCAGCCTCCAATTAAGAG											
2												
3												
4												
5												
6												
7												
8												

APPENDIX 2

Haplotypes of cytochrome oxidase I genes for specimens of five species of *Stylocactus* from various localities. **1**, *S. libratus*, Marquesas Is. (MNHN-Na 13457); **2**, *S. discissipes*, New Caledonia (MNHN-Na 15731); **3**, *S. discissipes*, Austral Is. (MNHN-Na 15726); **4**, *S. serratus*, Gibraltar (MNHN-Na 15732); **5**, *S. serratus*, Canary Is. (RMNH D 38035); **6**, *S. serratus*, West Indies, St. Vincent (RMNH D 38033); **7**, *S. multidentatus*, Fiji Is. (MNHN-Na 14981); **8**, *S. aff. pubescens*, Tonga Is. (MNHN-Na 15030).

	10	20	30	40	50	60	70	80	90	100	110	120
1	CACCCCTGA	A	G	T	A	T	T	T	A	T	T	A
2	.T	.....	C	..	C	..	T	C	..	G	..	C
3	.T	.....	C	..	C	..	T	C	..	C	..	T
4	.T	.....	T	..	C	..	T	T	..	G	..	G
5	.T	.....	T	..	C	..	T	T	..	C	..	G
6	.T	.....	T	..	C	..	C	T	..	C	..	G
7	.GT	.....	T	..		..	G	..	..	C	..	G
8	T	A	..	T	..	C	T	..	..	A	C	..
	130	140	150	160	170	180	190	200	210	220	230	240
1	ATTGGAGTTT	T	AGG	GT	T	G	T	G	AC	T	G	CA
2	.....	G	..	A	..	A	..	T	..	G	..	T
3	.....	G	..	A	..	T	..	T	..	G	..	T
4	.....	C	..	G	..	G	..	T	..	C	..	T
5	.....	C	..	G	..	G	..	T	..	C	..	T
6	.....	C	..	G	..	G	..	T	..	C	..	T
7	.....	CC	..	C	..	T	..	C	..	G	..	C
8	.....	CC	..	C	..	T	..	A	..	T	..	T
	250	260	270	280	290	300	310	320	330	340	350	360
1	ATCTT	TTA	GG	GT	AGG	AA	CC	AT	GG	CT	TC	CGCA
2	.....	A	..	A	..	T	..	C	..	G	..	T
3	.....	T	..	A	..	T	..	C	..	G	..	A
4	.....	T	..	A	..	T	..	C	..	G	..	A
5	.....	T	..	A	..	T	..	A	..	G	..	T
6	.....	T	..	A	..	T	..	A	..	G	..	T
7	.....	A	..	A	..	T	..	A	..	G	..	T
8	.....	A	..	A	..	C	..	C	..	C	..	T
	370	380	390	400	410	420	430	440	450	460	470	480
1	AACT	TT	CC	CT	CG	AT	TA	TT	GC	AG	GT	AT
2	.....	T	..	C	..	T	..	T	..	C	..	C
3	.....	T	..	C	..	T	..	T	..	C	..	C
4	.....	T	..	C	..	T	..	T	..	C	..	CC
5	.....	T	..	C	..	T	..	T	..	C	..	CC
6	.....	T	..	C	..	T	..	T	..	C	..	CC
7	.....	T	..	C	..	T	..	G	..	T	..	G
8	.....	T	..	A	..	T	..	C	..	T	..	A
	490	500	510	520	530	540	550	560				
1	TTT	ACT	GG	AT	TC	GT	AA	CC	AT	TT	TC	TT
2	.....	GC	..	A	..	T	..	G	..	T	..	C
3	.....	GC	..	A	..	T	..	G	..	C	..	C
4	.....	GC	..	A	..	T	..	G	..	C	..	C
5	.....	GC	..	A	..	T	..	G	..	C	..	C
6	.....	GC	..	A	..	T	..	G	..	T	..	C
7	.....	A	..	C	..	G	..	G	..	C	..	